The Drive & Control Company

Rexroth
Bosch Group

Large hydraulic cylinders: Customized solutions

The perfect fit

At Rexroth, your project is our challenge. We design and manufacture custom built cylinders, high pressure piston accumulators and pressure vessels for your individual applications. Our large hydraulic cylinders range from bore 200 mm up to 1.500 mm and strokes up to 24.000 mm. Our highly skilled specialists have a unique expertise for a large variety of industry sectors and know the special requirements of your application.

Rexroth has an outstanding track record of building large hydraulic cylinders for more than five decades. Our proven application-based engineering and production processes give you the assurance that every cylinder is perfectly crafted and suited to its task. Safe and reliable operations are important to all industries where these heavy cylinders are used. We work consistently to maintain industry-specific standards from classification societies such as LLOYD's Register, DNV, the American Bureau of Shipping, Rexroth and customer standards.

One of the most essential parts of large hydraulic cylinders is the piston rod surface. Rexroth has been a pioneer and trend setter in developing new technologies that improve uptime and reduce Total Cost of Ownership. All in-house surface technologies are bundled under the brand name Rexroth Enduroq.

Rexroth offers more than unusual dimensions and dedicated surface technologies. We deliver extra functionalities like integrated measuring systems, as well as complete drive and control solutions with perfectly matched power units, hydraulic piping and control systems. And we supply additional services like project management, engineering, commissioning, supervising and training. One-stop-shopping at Rexroth reduces the complexity of your project by instating clearly structured responsibilities.

As a global player with an international network in production, sales and service, Rexroth is always as big as you need it: as a cylinder supplier; as a main contractor for drive and control projects; and/or as a partner for lifecycle management support. Large hydraulic cylinders from Rexroth give your machinery the perfect fit – every time!

Further information: www.boschrexroth.com/lhc

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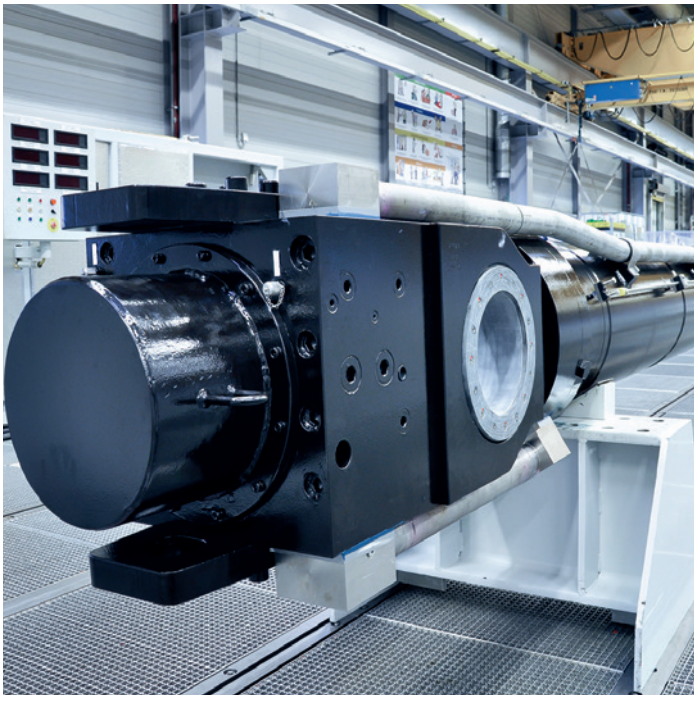


Engineering and production: Using the real performance potential

Large hydraulic cylinders are used to transmit heavy forces in often extreme environments. Additionally, they must operate reliably and safely over a long period of time. Only systemized engineering and production processes can make sure that the cylinder always meets the individual requirements. Rexroth has developed sophisticated design tools and unique inhouse research facilities for a reliable and cost-efficient cylinder design.

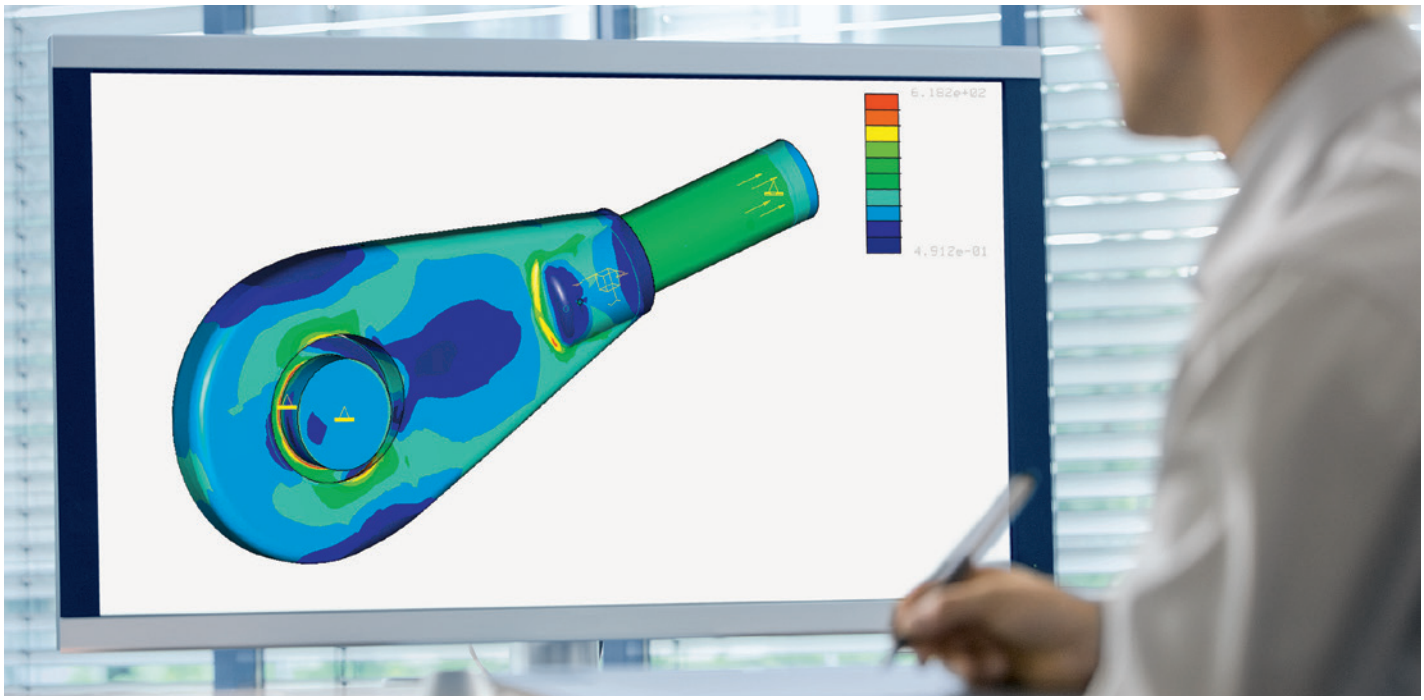
Avoiding deflection and buckling

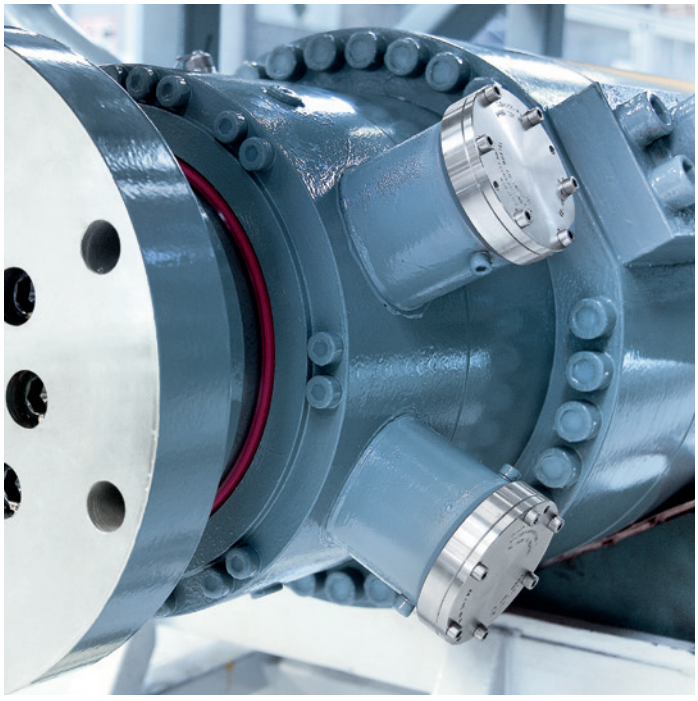
Our experts calculate the deflection and buckling of hydraulic cylinders. All typical mounting styles, friction moments in spherical bearings, transverse loads, accelerations and eccentric loads are taken into account. The calculations also encompass typical phenomena as ballooning of the shell, fabrication clearances in the cylinder guiding and identification of the bearing material. The result is a precise prediction of the cylinder under pushing as well as pulling loads.

The eccentric position of the rod in the head, as well as the piston in the shell, is thoroughly analyzed. Local stresses in the rod, shell and bearings are precisely calculated. In several cases a force stroke diagram is required. These advanced and detailed calculations are the basis for a reliable and cost-efficient cylinder design.

◄ **Unique inhouse research facilities**

► **Calculating every detail to develop the perfect cylinder that stands any individual demand**
► **Integrated electronics for measuring systems**





Preventing fatigue

Rexroth has developed several unique construction details, as well as a set of demands for the materials, in addition to the applicable standards. These details are calculated with FEM (Finite Element Method) and combined with calculation methods according to recognized standards in order to realise a reliable design without critical fatigue.

The calculations cover parameters such as material type and thickness, local stresses, amplitudes, stress gradients and the number of load cycles. A load spectrum is required for cylinders in dynamic applications.

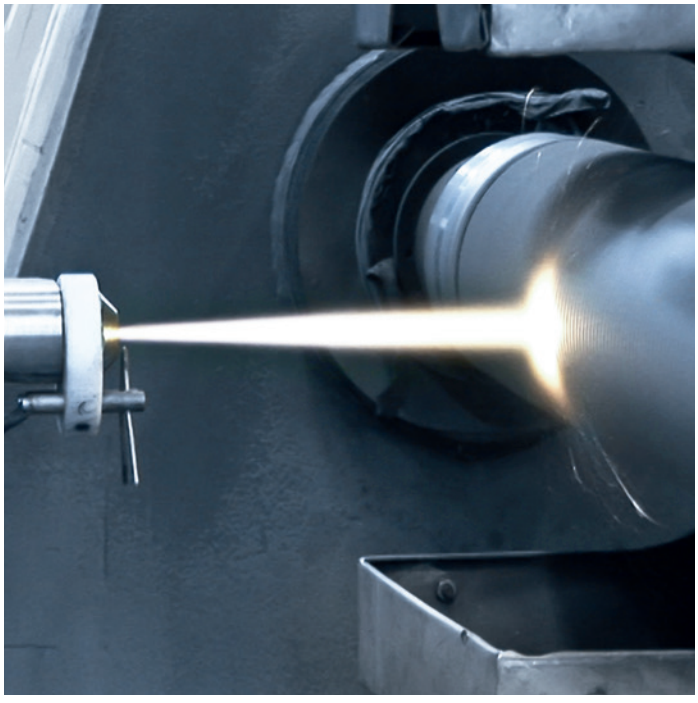
The art of surface technologies: Improving uptime whilst reducing Total Cost of Ownership

The piston rod surface of large hydraulic cylinders is one of the most essential parts of the hydraulic installation. The right combination of surface technology, seal concept and hydraulic medium defines the eventual uptime and Total Cost of Ownership. Rexroth has been one of the pioneers and trend setters in developing various in-house technologies for every industry and application.

Best surface technology

Rexroth Enduroq uses an integrated concept for selecting, engineering and producing the best surface technology in any industry or application. It bundles all in-house surface technologies for piston rods. To develop this concept, Rexroth analyzed service data from its installed cylinder base, which is the largest one in the world.

Enduroq 3200 is a dual layer, Ultimet-based, surface technology. It was specially developed for offshore splash zones (e.g. direct riser tensioners) and meets the highest qualification standard in the industry*. This standard has been developed by DNV in the Joint Industry Project, and Rexroth has played a prominent role in this development.



Other solutions
Other solutions for the cylinder rod surface include Enduroq 3000, a single layer Ultimet-based technology, as well as Enduroq 2000 and Enduroq 2200 which are both based on the proven HVOF technologies. Rexroth can also supply chromium-plated piston rods in applications where this has proven to offer the best combination of functionality, durability and Total Cost of Ownership.

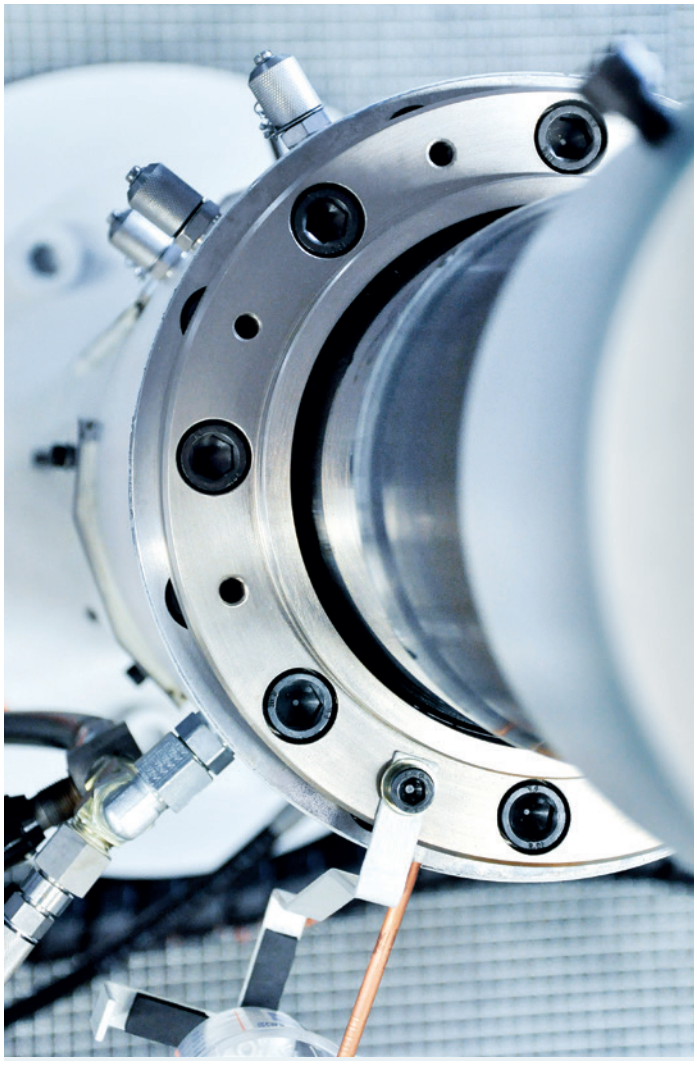
Seal configuration
Rexroth has developed a Seal Matrix for all kind of applications and piston rod surfaces. This matrix is the result of an extensive 'tribology' development program in co-operation with world leading seal manufacturers. Tribology analyzes friction, lubrication and wear of interacting surfaces in motion.

Some seal configurations are able to withstand the complete extrusion gap, fit for speeds up to 15 m/s, useable for low-friction applications and have excellent wear properties. Other seal configurations are adjustable, maintenance friendly and non-sensitive to dirt.

▶ **Exposed environment** ▼ **Surface technology**	Non-corrosive environment	Mild marine atmospheric open zone	Marine atmospheric sheltered zone	Seawater submerged, marine splash zone
Chromium	●			
Ni/Chromium	●	●		
Enduroq 2000	●	●	●	
Enduroq 2200	●	●	●	●
Enduroq 3000	●	●	●	●
Enduroq 3200	●	●	●	●

◀ **Rexroth Enduroq surface technologies for piston rods**
▶ **Seal testing**

**Guideline for qualification of wear and corrosion protection surface materials for piston rods (Report No. 2009-3295; revised 2010).*

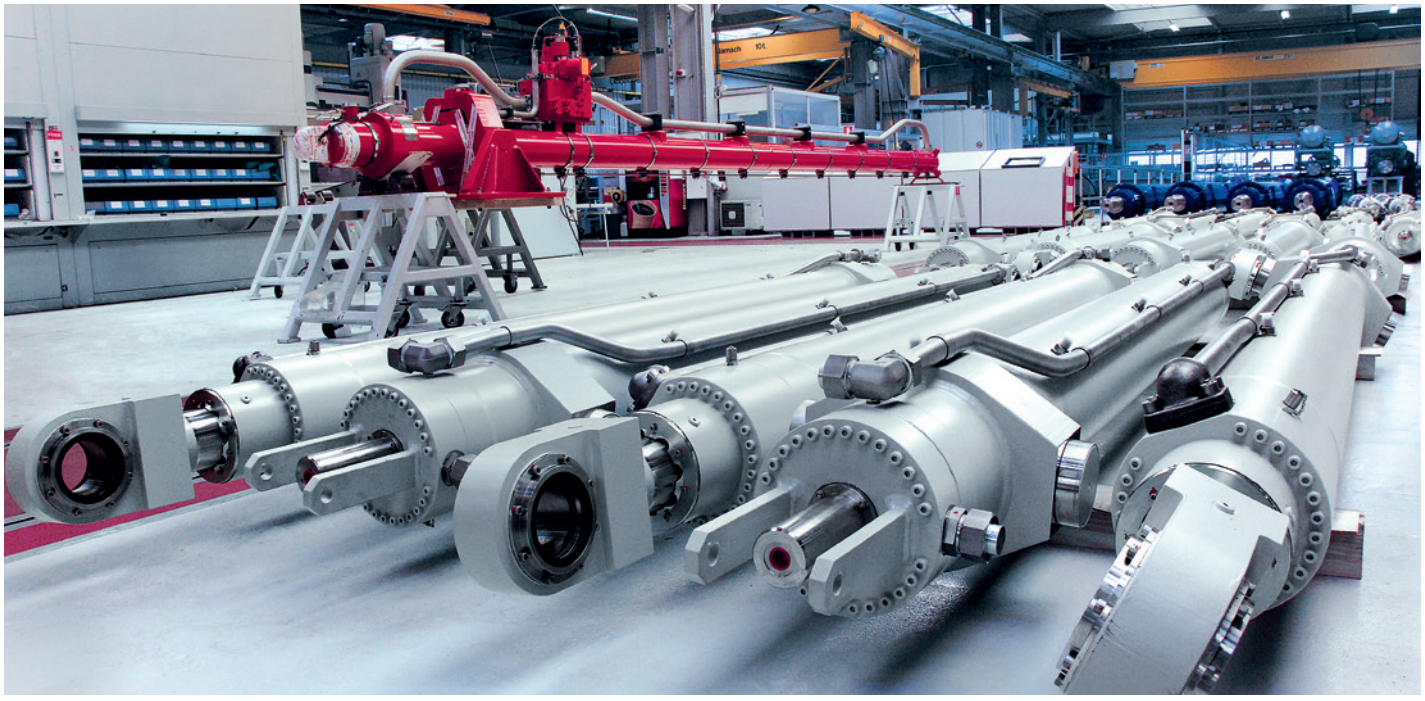


Life cycle management: Improving overall equipment effectiveness

More than 90 % of the life cycle costs are determined during the design phase. As a partner already in the engineering phase of the installation, Rexroth can save you maintenance time and costs, not to mention improving availability over the complete life cycle.

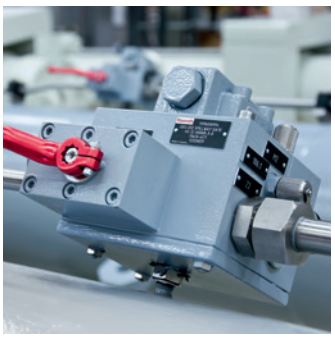
Unique developments
Rexroth has developed unique construction details and piston rod technologies which offer a twofold advantage: in addition to a longer life span, Rexroth cylinders also save maintenance time and improve the uptime and profitability of installations.

Repair and maintenance
Rexroth offers a wide range of repair and maintenance services. Our maintenance concept is made up of spare part management and delivery, field service, regular health checks and inspections, repair and overhaul services and technology upgrades. With various specialised service centres around the globe to support your maintenance operations.



All manufacturing processes are organized according to BPS, the Bosch Production System, which is based on the principles of lean-manufacturing.

Rexroth lifecycle management comprises services for your application all over the world.



Marine:
Ready for continuous challenges

Dredging
- trailing suction hopper dredger
- cutter-suction dredger
- spud hoist dredger
- split hopper dredger
- split barge
- piling barge
- stone dump barge
- pipe laying vessels

Naval
- AOR replenishment
- special equipment

Dredging, pipe laying or barges, in marine applications project cylinders have to perform under high forces and extreme environmental conditions. Rexroth offers customized, individual solutions perfectly matching to the requirements. Due to our extensive experience with classification bureaus, such as Bureau Veritas, DNV, ABS, LROS, Lloyds, GL, and others, Rexroth cylinders meet the specification right from the start.

Special Features
- optimum design because of application experience and highly specialized calculation and simulation tools
- piston rod coating with an extremely high wear and corrosion resistance
- first class seal and bearing configuration
- special shell mounted bearing against unpredictable axial forces
- cylinder integrated measuring system

Bottom door cylinder
to open the bottom doors of suction dredgers

Piston diameter:	480 mm
Piston rod diameter:	200 mm
Stroke length:	3,350 mm
Application:	submerged in sea water

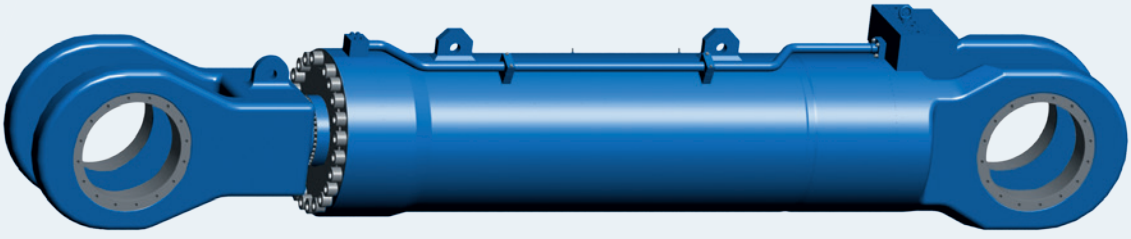
The deepening and maintaining of ports, rivers or canals is a continuous challenge. Dredging strongly depends on reliable, specialized large hydraulic cylinder technology.

Cylinder for piling barge

Piston diameter:	1,000 mm
Piston rod diameter:	650 mm
Stroke length:	12,870 mm
Application:	installation of piles in the sediment

Cylinder for split barge

Piston diameter:	900 mm
Piston rod diameter:	400 mm
Stroke length:	3,500 mm
Application:	split barge, transportation of soil that hopper and cutter dredgers obtain during work



Offshore:
Cylinders made for toughest demands

Heave compensation	▶ wire line tensioning ▶ direct riser tensioning ▶ passive/active heave compensation ▶ linear concepts
Skidding	▶ rig skidding ▶ load out skidding
Deck mating	▶ deck mating systems ▶ fender systems ▶ integrated skidding systems ▶ decommissioning systems
Jacking	▶ positive engagement systems ▶ rack and pinion systems ▶ hydraulic concepts

Designed for the aggressive offshore environment Rexroth cylinders meet the highest demands regarding safety, corrosion resistance and heavy duty operation. As the leading supplier Rexroth is continuously adopting new technologies. Intensive interaction with OEMs, end-users and consultants ensures that we understand market demands, whether it is deep-sea, arctic or any other demanding offshore application.

Special features

- ▶ cylinder designs based on decades of knowledge and field experience
- ▶ extremely high wear and corrosion resistance
- ▶ high quality seal and bearing configuration
- ▶ integrated high quality piping
- ▶ unique solution for Position Measuring system
- ▶ measuring systems for potentially explosive atmospheres
- ▶ welding for low temperature applications.

Riser tensioner cylinder for oil-drilling vessels

Piston diameter:	560 mm
Piston rod diameter:	230 mm
Stroke length:	16,300 mm
Application:	dynamic application in aggressive environments

Whether high in the derrick, in the moon pool or deep down under water: Large hydraulic cylinders from Rexroth are accurate, reliable and cost effective.

Cylinder for jack up system

Piston diameter:	600 mm
Piston rod diameter:	280 mm
Stroke length:	3,150 mm
Application:	transforming a ship into a platform

Cylinder for heave compensation

Piston diameter:	300 mm
Piston rod diameter:	220 mm
Stroke length:	3,750 mm
Application:	compensating tidal influences on the system

Civil Engineering: Reliable solutions for highest uptime

Power generation	▶ radial gates ▶ flap gates ▶ intake gates ▶ bottom outlet ▶ turbine regulation ▶ valves
Ship locks	▶ miter gates ▶ culvert gates ▶ double hook gates ▶ sector gates
Moveable bridges	▶ bascule bridges ▶ lifting bridges ▶ swing bridges ▶ roll-on/roll-off bridges
Barriers	▶ roller/sliding gates

Due to the critical functions, operation has to be secured under all circumstances. Rexroth is constantly in close contact with governments, consultants and contractors. All solutions are designed to specific standards and regulations like DIN, ASME, JADEE, NEN. Our experience with design standards and sector related requirements lead to lowest possible Total Cost of Ownership.

Special features

- ▶ extreme resistance against corrosion, scratch and wear
- ▶ first class seal and bearing configuration
- ▶ integr. measuring system, with or without redundancy
- ▶ submerged solutions possible
- ▶ mechanical locking system
- ▶ integrated oil reservoir possible
- ▶ special options for low temperature operations
- ▶ oil supply through piston rod possible

Bottom outlet cylinder for hydro power dam

Piston diameter:	450 mm
Piston rod diameter:	150 mm
Stroke length:	15,415 mm
Application:	partly submerged and low dynamic

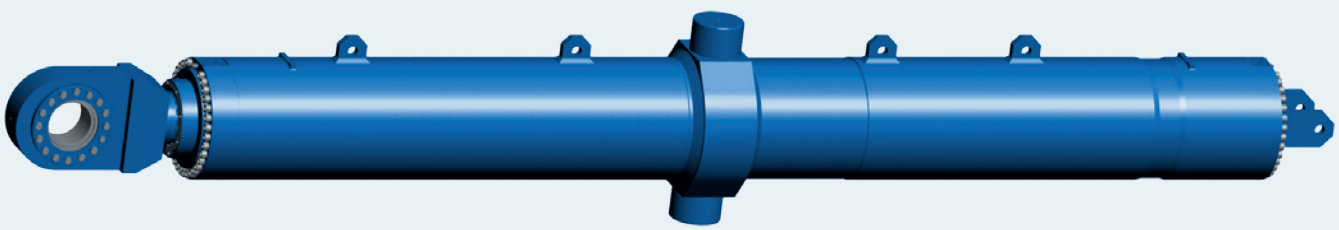
Whether you are constructing power generation plants, dams, ship locks, bridges or barriers, Rexroth is your worldwide partner for civil engineering.

Miter gate cylinder for ship locks

Piston diameter:	300 mm
Piston rod diameter:	160 mm
Stroke length:	3,700 mm
Application:	medium dynamic, operating in splash zone

Cylinder for bascule bridge

Piston diameter:	540 mm
Piston rod diameter:	280 mm
Stroke length:	5,500 mm
Application:	low friction, heavy mass movement



General industrial applications and presses: Life time and durability

General industry
- pressure intensifiers
- cement rolling mills

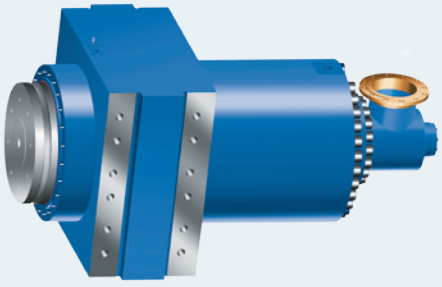
Presses
- metal forming
- extrusion
- injection moulding
- compactors
- jack rams

The environment and working conditions are usually hard and intensive due to the frequency of movement and 24/7 operations. Life time and durability are key words to our engineers for custom tailored cylinders.

Special features
- optimal design because of application experience and highly specialized calculation and simulation tools
- piston rod surface technology, where required, with an extremely high wear and corrosion resistance
- first class seal and bearing configuration for demanding environments and long life time
- special rod sealing for submerged solutions
- manifold block, pre-fill valve or measuring system integrated in the cylinder design
- integrated high quality piping
- special design based on fatigue calculations

Main pressing cylinder for baling presses

Piston diameter:	720 mm
Piston rod diameter:	700 mm
Stroke length:	600 mm
Application:	multi shift high cycle movement under harsh conditions



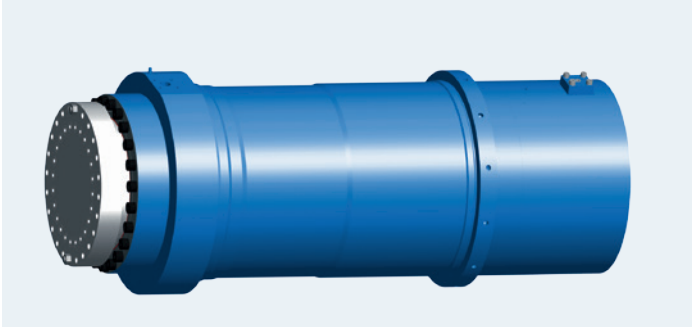
Highly dynamic applications, such as presses for scrap, paper, baling, laundry and pipe bending require special features.

Press cylinder with jack ram for slab press

Piston diameter:	480 mm
Piston rod diameter:	440 mm
Stroke length:	2,350 mm
Application:	high efficiency with low force high speed, approach and pull back

Double acting press cylinder for forging press

Piston diameter:	800 mm
Piston rod diameter:	750 mm
Stroke length:	1,950 mm
Application:	high impact load case under severe working conditions



Steel mill and rolling mill applications: Cylinders that will stand the heat

Continuous casting machines	▶ ladle turrets ▶ rotary joints ▶ segment
Rolling mills	▶ automatic gauge control ▶ roll change ▶ coiler
Secondary metallurgy	▶ ladle lift
Furnaces	▶ melting furnaces ▶ re-heat furnaces
Non ferrous casters	▶ vertical casting table control

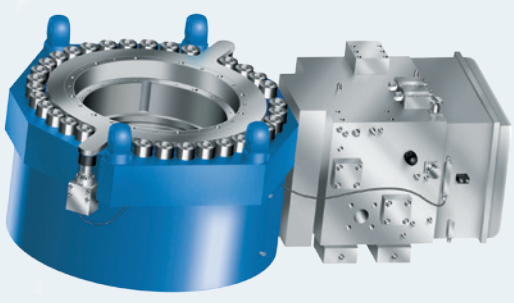
The sheer force is impressive: In a plate mill a Rexroth custom built cylinder delivers a rolling force of 90,000 kN with a bore up to 1,500 mm. The environment in this industry is harsh and demanding with strong vibrations, high temperatures, dust and pollution. Most of the cylinders are expected to operate for several years in 24/7 operation.

Special features

- optimal design because of application experience and highly specialized calculation and simulation tools
- piston rod surface technology with an extremely high wear and corrosion resistance
- first class seal and bearing configuration for harsh and aggressive environment
- special rod sealing and coating for submerged solutions
- manifold block and measuring system integrated in the cylinder design
- integrated piping

Automatic gauge cylinder for roll gap control

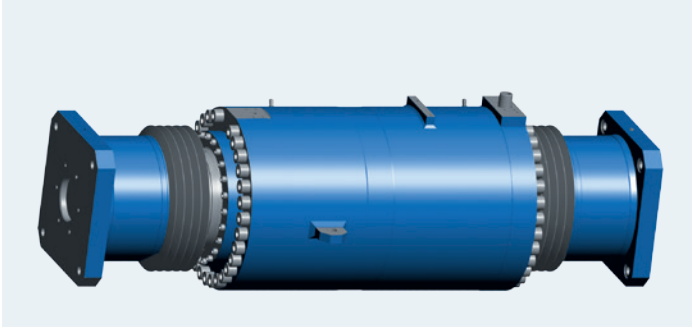
Piston diameter:	1,100 mm
Piston rod diameter:	950 mm
Stroke length:	40 mm
Application:	accurate, dynamic strip thickness control by high res. and integrated measurement- and servo-system



Strong vibrations, high temperatures, dust and pollution. The environment and working condition in heavy industry applications is harsh and demanding.

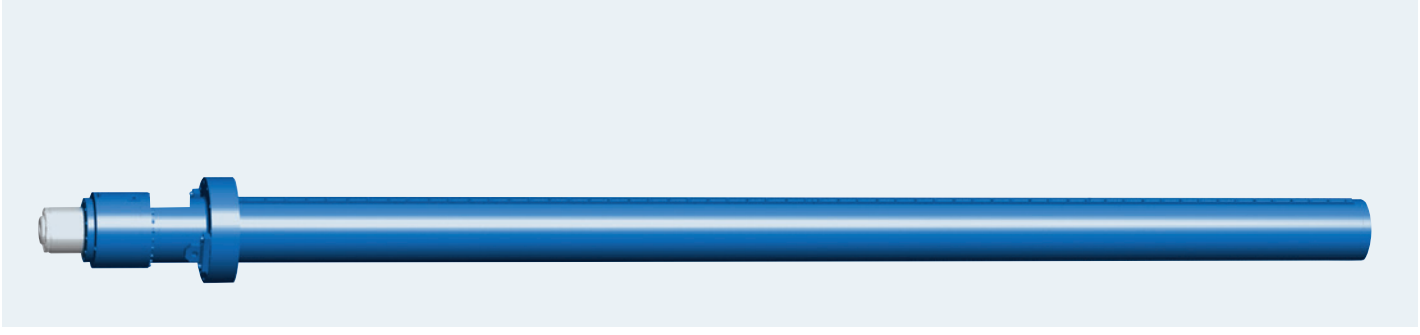
Ladle turret cylinder
for continuous casting

Piston diameter:	650 mm
Piston rod diameter:	450 mm
Stroke length:	645 mm
Application:	steel casting machinery continuously operating in high temperatures



Non ferrous casting cylinder
for billet or slab casting

Piston diameter:	380 mm
Piston rod diameter:	320 mm
Stroke length:	8,000 mm
Application:	underwater billet casting with a long stick-slip poor movement



Bulk materials handling and mining: Right dimension for heavy work

Surface mining	▶ stacker/reclaimers ▶ bucket wheel excavators ▶ belt wagons ▶ transport crawlers ▶ spreaders ▶ excavators
Bulk materials handling	▶ level luffing cranes ▶ ship loaders ▶ ship unloaders ▶ stack/reclaimers ▶ belt wagons ▶ spreaders
Tunnel boring machines	▶ hard rock tunneling ▶ shield tunneling

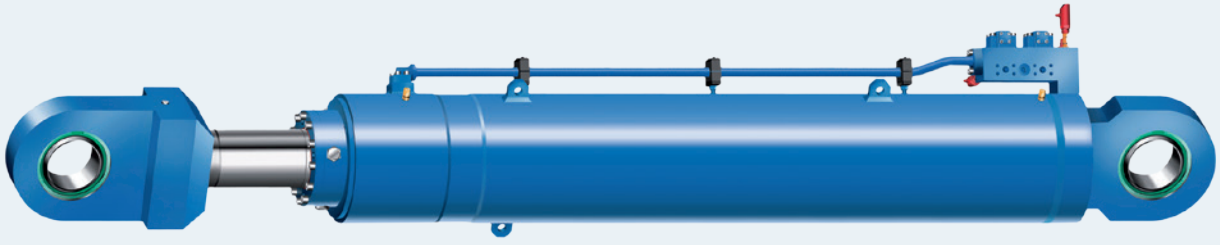
In the mining industry large hydraulic cylinders operate non-stop with all kinds of materials under extreme conditions, whereas in bulk materials handling they have to withstand abrasive and seaport conditions or high vibration levels. Cylinders in tunnel boring machines are exposed to wear-intensive circumstances, whilst dealing with extreme side loads and torque acting on the cutting head.

Special features

- ▶ optimal design because of application experience and highly specialized calculation and simulation tools
- ▶ extremely high wear and corrosion resistance
- ▶ first class seal and bearing configuration
- ▶ unique pre-stressed piston/piston rod connection for dynamic operation
- ▶ spherical bearing protection system
- ▶ spare sealing flange premounted on the piston rod
- ▶ welding for low temperature applications
- ▶ integrated piping, manifold block and measuring system

Boom cylinder for track loader

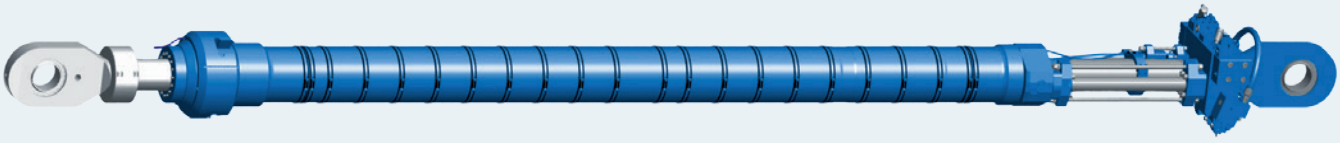
Piston diameter:	320 mm
Piston rod diameter:	180 mm
Stroke length:	1,735 mm
Application:	open-cast mining under abrasive and dirt conditions



Low weight and compact design, but at the same time a demand for high durability in extreme conditions: Rexroth cylinders perfectly meet the special demands and challenges, avoiding over dimensioning.

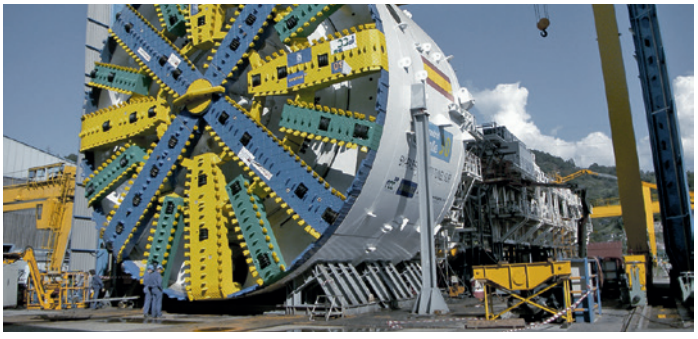
Cylinder for hydraulic mining shovel

Piston diameter:	360 mm
Piston rod diameter:	250 mm
Stroke length:	6,198 mm
Application:	oil extraction from Canadian tar fields



Thrust cylinder for shield tunneling

Piston diameter:	400 mm
Piston rod diameter:	280 mm
Stroke length:	1,700 mm
Application:	tunnel boring in wear-intensive circumstances



Special projects: Unusual design for unusual demands

Stadiums	▶ movable roofs ▶ movable floors ▶ platform supports
Theatres	▶ movable stages ▶ movable sceneries ▶ transport equipment
Elevators	▶ lifting equipment ▶ accumulator systems
Geothermics	▶ deep drilling

Our expertise in special projects supports you to realize the most challenging architectural designs. Movable roofs, for example in sport stadiums, typically are static large structures. Unstable movement should be avoided by all means because of high safety standards. For theatres and elevators, it is necessary to develop a compact design because of the limited built in space. Reducing stick-slip and noise levels are key in these applications.

Special features

- optimized tribology system in order to avoid stick-slip
- in-house simulation of dynamic system
- integrated measuring system to control movement
- optimal design to reduce built in dimensions
- high safety factors due to exceptional rules and regulations

Special cylinders for movable roofs

Piston diameter:	840 mm
Piston rod diameter:	400 mm
Stroke length:	15,213 mm
Application:	tennis arena with three movable roofs

Large cylinders in special projects have to meet various requirements related to design standards, position measuring and mounting styles.

Theatre cylinder
for hydraulic movable floor

Piston diameter:	350 mm
Piston rod diameter:	300 mm
Stroke length:	13,778 mm
Application:	national theatre with movable floors

Special cylinders for deep drilling

Piston diameter:	280 mm
Piston rod diameter:	250 mm
Stroke length:	11,000 mm
Application:	onshore and offshore oil and geothermic deep drilling

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R999000121 (2012-02)
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